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PART II

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

PROPOSED U.S. NATIONAL AVIATION STANDARD FOR THE DISCRETE ADDRESS BEACON SYSTEM (DABS)

[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

DISCRETE ADDRESS BEACON SYSTEM (DABS)

Notice of Proposed U.S. National Aviation Standard

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of Proposed National Aviation Standard.

SUMMARY: This action proposes a U.S. National Aviation Standard for the Discrete Address Beacon System (DABS). The standard would define the system and the performance characteristics of its components. It is intended to satisfy overall operational needs and assure compatibility with all elements of the National Airspace System (NAS). While not regulatory, the standard may provide the basis for later rule making affecting airborne navigational equipment.

DATES: Comments must be received on or before May 26, 1978.

ADDRESS: Director, Systems Research and Development Service, Attn: ARD-50, Federal Aviation Administration, Department of Transportation, Trans Point Building, 2100 Second Street SW., Washington, D.C. 20591.

FOR FURTHER INFORMATION CONTACT:

P. D. Hodgkins, Surveillance Branch, ARD-240, Communications Division, Systems Research and Development Service, Federal Aviation Administration, 2100 Second Street SW., Washington, D.C. 20591, telephone 202-426-4085.

SUPPLEMENTARY INFORMATION:

NOTE.—This draft is issued for public comment only, conventions and formats are subject to change.

DESCRIPTION

The Discrete Address Beacon System is an important element of the Upgraded Third Generation Air Traffic Control System. It is a fully compatible evolutionary upgrading of the Air Traffic Control Radar Beacon System (ATCRBS) currently deployed. It provides the improved surveillance and data link communications required to support the automation which will be provided by the Upgraded Third Generation Air Traffic Control System and enhanced developments of future Air Traffic Control (ATC) automation. DABS has been under deployment since 1972.

DEFINITION OF U.S. NATIONAL AVIATION STANDARD

U.S. National Aviation Standards are system standards embodying descriptions of system characteristics. They are issued by the Administrator of the Federal Aviation Administration (FAA), Department of Transportation (DOT). They describe the performance characterisitics (the technical parameters, tolerances and techniques) of major elements of the system to the extent necessary to assure proper operation and interface compatibility between elements of the National Airspace System (NAS). U.S. National Aviation Standards generally are limited to cooperative air-to-ground subsystems involving government owned ground equipment and private airborne equipment. For example, the ATCRBS National standard describes those performance characteristics of the ground and airborne components necessary to assure effective operation of radar beacon carried by military and civil aircraft as effective elements of national air traffic procedures. U.S. National Aviation Standards are not equipment specifications or standards pertaining to planning, programming, component equipments, siting, installation, availability, reliability, or maintainability.

RELATIONSHIP OF U.S. NATIONAL AVIATION STANDARD TO FEDERAL AVIATION REGULATIONS

U.S. National Aviation Standards issued by the Administrator in agency orders are binding only on FAA organizational elements. They establish the technical base and description of the NAS and component subsystems. Since they are not promulgated as Federal Aviation Regulations by the rule-making process prescribed by 5 U.S.C.533 they are not regulatory standards imposing duties on the public. With respect to the public, such standards are only advisory and their issuance is not rule making. However, while they are not regulatory, U.S. National Aviation Standards may serve as the basis for subsequent rule-making actions. Because of the relationship between U.S. National Aviation Standards and possible subsequent regulatory actions, FAA publishes such standards in the FEDERAL REGISTER and solicits public comment prior to their approval by the Administrator. In addition, publication of such issuances is consistent with the public information provisions of 5 U.S.C. 552 (a)(1)(D) which requires each government agency to publish in the FEDERAL REGISTER statements of general policy.

INVITATION OF PUBLIC COMMENT

Although comments are solicited on all aspects of the draft standard, the FAA is specifically interested in comments and suggestions in two areas: (1) the cost impact of items included to improve performance in the ATCRBS mode of DABS, paragraph 2.3.1.1.1 and (2) changes in general that will minimize aoverall transponder costs.

Interested persons are invited to submit written comments on this proposed U.S. National Aviation Standard on or before May 26, 1978. Communications should be submitted in duplicate to: Director, Systems Research and Development Service, Attn: ARD-50, Federal Aviation Administration, Department of Transportation, Trans Point Building, 2100 Second Street SW., Washington, D.C. 20591.

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U.S. NATIONAL AVIATION STANDARD FOR THE DISCRETE ADDRESS BEACON SYSTEM

1. *General.*

1.1 *System Features.*

1.1.1 *Background.*

1.1.1.1 *The Function of DABS.* The Discrete Address Beacon System (DABS) is an improved secondary radar system with an intergral two way data link. DABS differs from ATCRBS in the manner of selecting which aircraft will respond to an interrogation. In ATCRBS, the selection is spatial; in DABS, each aircraft is assigned a unique address code. Thus, an interrogator is able to limit its interrogations to those targets for which it has surveillance responsibility, and to time the interrogations to ensure that the responses from aircraft do not overlap. In addition, the discrete address provides the basis for a ground-air-ground digital data link. The main requirements of DABS are to:

a. Support automated air traffic control (ATC) with improved surveillance and communication capability and reliability in the projected 1995 traffic environment.

b. Permit evolutionary implementation at lowest user cost.

1.1.2 *Rationale for the DABS National Standard.*

1.1.2.1 Under public law 85-726, the Federal Aviation Administration has the responsibility for the development and operation of a common system of air traffic control and navigation for both military and civil aircraft. Explicitly, the Administrator shall develop, modify, test and evaluate systems, procedures, facilities, and devices, as well as define the performance characteristics thereof, to meet the needs for safe and efficient navigation and traffic control of all civil and military aviation.

1.1.2.2 Systems selected for implementation as a result of these developments, modifications, test and evaluation efforts are described in U.S. National Aviation Standards. These are system standards embodying descriptions of system characteristics. They describe technical parameters, tolerances and techniques that ensure proper operation and compatability between elements of the National Airspace System.

1.1.2.3 Optimum performance will be obtained if these System Characteristics are met by all users of the Discrete Address Beacon System under all expected operating conditions. Consequently, it is important to define many characteristics of the airborne components used in the system.

1.2 *Coordination DABS with the Air Traffic Control Radar Beacon System (ATCRBS).*

1.2.1 *ATCRBS Compatibility.* To facilitate the transition from ATCRBS to DABS over an extended period, DABS installations, both ground and airborne, include full ATCRBS capability. DABS interrogators provide surveillance of ATCRBS-equipped aircraft, and DABS transponders are capable of replying to ATCRBS interrogators. To accomplish this dual mode operation (ATCRBS and DABS) with minimum equipment complexity, DABS operates on the same interrogation and reply frequencies as ATCRBS.

1.2.2 *Relationship Between DABS and ATCRBS National Aviation Standards.* ATCRBS-only transponders are not affected by the DABS National Aviation Standard, and the ATCRBS-mode operation of DABS transponders adheres to the ATCRBS National Aviation Standard.

1.2.3 *ATCRBS IFF XII System (AIMS) Compatability.* The DABS system has been

designed to proclude mutual interference with AIMS with specific attention to Mode 4 operations thereof.

1.3 *Scope of this Standard.* This National Standard is a description of the characteristics of the DABS System in terms of signals and formats handled and processed by all users.

1.3.1 *Items Not Covered.* This is not a per- formance standard; performance standards will be proposed based on this National Standard.

1.4 *Overall System Performance and Capabilities.*

1.4.1 *Coverage.* The DABS sensor will perform surveillance of all beacon-equipped aircraft within its line-of-site coverage airspace. The nominal range is 200 nmi, but is site adaptable to other ranges. ATCRBS-equipped aircraft will be interrogated at the minimum rate that produces an adequate number of interrogations for azimuth determination. DABS-equipped aircraft will be acquired by means of an All-Call interrogation, or by means of ground-to-ground handover. After acquisition, DABS-equipped aircraft will be interrogated with their unique address call. For both ATCRBS and DABS-equipped aircraft, azimuth will be determined by a monopulse technique. System coverage for both ATCRBS and DABS is intended to be analogous to the performance described in FAA Selection Order 1010.51A, paragraph 1.3.2.

1.4.2 *Data Link.* The DABS sensor will provide a two-way digital data link for all DABS-equipped aircraft. Messages originating on the ground will be sent to suitably equipped aircraft and appropriate acknowledgement received will be relayed to the sender. The DABS sensor will also manage the data link so that when an aircraft wishes to initiate an air-to-ground message, that message will be read out with minimum delay.

1.4.3 *Link Reliability.* High link reliability is achieved by design features intrinsic to the DABS system. Reinterrogation reduces link failure due to interference. Signal formats, DPSK on the uplink and PPM with error correction capability on the downlink, provide immunity to interference. Discrete addressing eliminates synchronous interference.

2. *System characteristics.*

2.1 *Interrogation Signal Level.* The effective radiated peak power of all interrogation pulses (ATCRBS as well as DABS) shall be as prescribed by FAA Selection Order 1010.51A, paragraph 2.8.2.1.

2.2 *Link Technical Characteristics.*

2.2.1 *Interrogation Signal Characteristics.*

2.2.1.1 *Classes of DABS Interrogations from DABS Sensors.* Two classes of DABS-type interrogations are transmitted by a DABS sensor:

a. ATCRBS/DABS All-Call interrogations.
b. DABS interrogations.

NOTE.—ATCRBS/DABS All-Call interrogations are used for surveillance of ATCRBS-equipped aircraft and for acquisition of DABS-equipped aircraft. DABS interrogations are used for surveillance and for data link communications with DABS-equipped aircraft on a sensor's surveillance roll-call; in addition, the DABS-Only All-Call may be used, if needed, for the initial acquisition of DABS aircraft without triggering replies from ATCRBS-equipped aircraft.

2.2.1.2 *Interrogation Carrier Frequency.* The carrier frequency of the main beam interrogation transmission shall be 1030±0.01 MHz. The carrier frequency of the ATCRBS SLS control pulse shall be as specified in FAA Selection Order 1010.51A, paragraph 2.1.1, U.S. National Aviation Standard for the Mark X (SIF) Air Traffic Control Radar Beacon (ATCRBS) Characteristics.

2.2.1.3 *ATCRBS/DABS All-Call Interrogations.*

2.2.1.3.1 *Structure.* An ATCRBS/DABS All-Call interrogation consists of three pulses: P_1, P_3, and P_4, as illustrated in Fig. 2.2.1-1. One or two control pulses, P_2 or P_1 and P_2, may be transmitted using a separate antenna pattern to suppress responses from aircraft in the sidelobes of the interrogator antenna.

NOTE.—The ATCRBS/DABS All-Call interrogations are similar to the corresponding ATCRBS interrogations as defined in FAA Order 1010.51A, paragraph 2.4, but with an additional pulse P_4 following P_3. ATCRBS transponders are unaffected by the presence of the P_4 pulse, and respond with normal ATCRBS replies. DABS transponders recognize the interrogation as a DABS All-Call interrogation and respond with DABS All-Call replies.

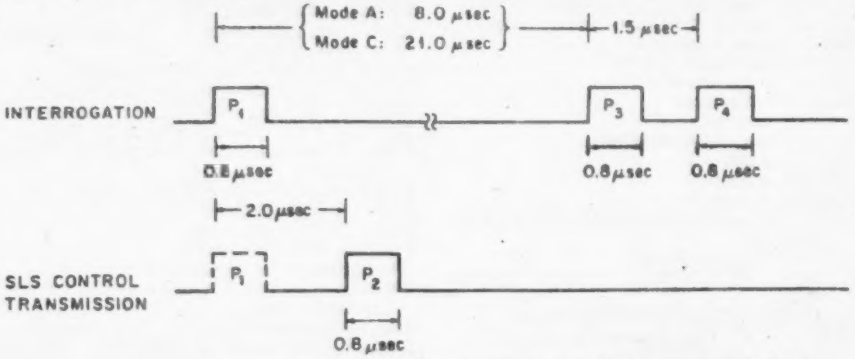


Fig. 2.2.1-1. ATCRBS/DABS All-Call Interrogations.

2.2.1.3.2 *Pulse Definitions.* Pulse width, spacing, rise and decay times, and tolerances thereon for pulses P_1, P_2 and P_3 shall be as defined in FAA Selection Order 1010.51A, paragraph 2.4.

2.2.1.3.3 *Pulse intervals.* The interval between the leading edges of P_3 and P_4 shall be 1.5±0.1 μsec.

2.2.1.3.4 *Pulse Duration.* The duration of pulse P_4 shall be 0.8±0.1 μsec.

NOTE.—DABS interrogators with omnidirectional antennas may interrogate ATCRBS targets with a modified ATCRBS/DABS All-Call interrogation in which the duration of P_4 is 1.6±0.1 μsec. It is intended that this special interrogation elicit replies only from ATCRBS transponders and that DABS transponders reject this interrogation by discriminating against long P_4 pulses.

2.2.1.3.5 *Pulse Shape.* The rise time and decay time of pulse P_4 shall be as defined in FAA Selection Order 1010.51A, paragraph 2.4 for pulses P_1, P_2, and P_3.

2.2.1.3.6 *Pulse Level, P_4.* The radiated amplitude of P_4 shall be within 1 dB of the radiated amplitude of P_1.

2.2.1.3.7 *Pulse Level, P_2, P_3.* The radiated amplitudes of P_2 and P_3 compared to P_1 shall be as defined in FAA Selection Order 1010.51A, paragraph 2.5

2.2.1.4 *DABS Interrogations.* A DABS interrogation consists of a preamble followed by a data block containing 56 or 112 data bits. The signal format is illustrated in Fig. 2.2.1-2.

2.2.1.4.1 *Preamble.* The preamble consists of a pair of pulses P_1 and P_3, nominally spaced 2 μsec leading edge to leading edge, which are both radiated in the mainbeam to intentionally suppress ATCRBS transponders which receive the interrogation. Pulse spacing, widths, and rise and decay times shall be as defined in FAA Selection Order 1010.51A, paragraphs 2.4 and 2.5 for pulses P_1 and P_3 of an ATCRBS interrogation. (Spacing: 2.0±0.15 μsec; Width: 0.8±0.1 μsec; Rise: 0.05 to 0.1 μsec; Decay: 0.05 to 0.2 μsec.)

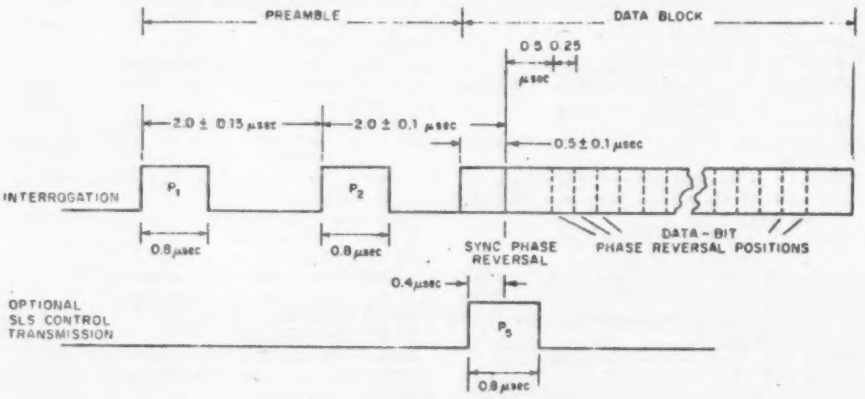


Fig. 2.2.1-2. DABS Interrogation

2.2.1.4.1 *Data Block.* The data block consists of a single RF pulse of duration 15.5±0.25 or 29.5±0.25 μsec beginning nominally 1.5 μsec after the leading edge of P_3. Data modulation is accomplished by phase reversals of the RF signal.

NOTE.—The data block RF pulse includes an additional 0.5 μsec segment at the end to assure that the trailing edge of the RF pulse does not interfere with the last bit in the data block.

2.2.1.4.3 *Data Block Shape.* The rise and decay times of the RF carrier pulse for the data block shall be as defined in FAA Selection Order 1010.51A, paragraph 2.4 for pulses P_1, P_2, and P_3 of an ATCRBS interrogation.

2.2.1.4.4 *Pulse Level.* The radiated amplitude of P_3 and the initial 1−μsec segment of the data block shall be greater than the radiated amplitude of P_1 minus 0.25 dB. The envelope amplitude variation of the data block over either a long or short DABS transmission shall not exceed 1 dB.

2.2.1.4.5 *Sync Phase Reversal.* The first phase reversal in the data block is the sync phase reversal and shall occur 2.0±0.1 μsec after the leading edge of P_3. The leading edge of the data block shall occur 0.5±0.1 μsec before the sync phase reversal.

2.2.1.4.6 *Bit Content.* Each data block includes 56 or 112 data bits transmitted at a 4− Mb/sec rate.

2.2.1.4.7 *Modulation Type.* Differential Phase Shift Keyed (DPSK) modulation is used, with a 180° phase change of the carrier at a data bit phase reversal position representing a binary one, and no phase change representing a binary zero.

2.2.1.4.8 *Phase Reversal Spacing.* Each carrier phase reversal shall occur at a time (N x 0.25)±0.02μsec (N>2) after the sync phase reversal. Thus, the first time a data bit phase reversal can occur is 0.5 ±0.02 μsec after the sync phase reversal.

2.2.1.4.9 *Phase Reversal Timing.* The time required for a phase reversal of the transmitted signal shall not be greater than 0.08 μsec as measured between the 10° and 170° points of the phase transition. The interval between the 80 percent points of the amplitude transient associated with the phase reversal shall not exceed 0.08 μsec.

2.2.1.4.10 *Tolerance.* The tolerance on the 0 or 180° phase relationship between successive chips in the DPSK signal (including the sync phase reversal) shall be ±5 degrees.

2.2.1.5 *DABS Transmit Sidelobe Suppression (SLS).* An optional control pulse P_5 may be transmitted to permit the DABS transponder to reject interrogations recieved from a sidelobe of an interrogator.

2.2.1.5.1 *Pulse Shape.* The control pulse P_5 shall be 0.8±0.1 μsec long. The leading edge of pulse P_5 shall be transmitted 0.4±0.05 μsec before the sync phase reversal. The rise time and decay time of pulse P_5 shall be as defined in FAA Selection Order 1010.51A, paragraph 2.4 for pulses P_1, P_2, and P_3 of an ATCRBS interrogation.

2.2.1.5.2 *Pulse Level.* The control pulse P_5 shall be radiated with the same antenna pattern and amplitude used for the P_3 control pulse of an ATCRBS/DABS All-Call Interrogation.

NOTE.—For an aircraft not in the main beam of the interrogator, the received P_5 pulse amplitude will exceed that of the data block. The transponder then will not detect the sync phase reversal, and thus will not attempt to decode the remainder of the data block.

2.2.1.5.3 *Pulse Carrier Frequency.* The carrier frequencies of P_5 and of the DABS data block shall not differ from each other by more than 0.1 MHz.

2.2.1.6 *DABS Sensor Emission Spectrum.* The maximum allowed emission spectrum for a DABS sensor shall be as described below:

Frequency difference (from carrier MHz)	Relative response (dB down from peak)
0	0
2.5	0
3.5	3.0
8.0	16.0
18.0	30.0
60.0	50.0

2.2.2 *Reply Signal Characteristics.*

2.2.2.1 *Classes of Replies from DABS Transponders.* Two classes of replies are generated by a DABS transponder:

a. ATCRBS replies (Mode A and Mode C).

b. DABS replies.

ATCRBS replies are generated in response to normal ATCRBS interrogations. DABS replies are generated in response to ATCRBS/DABS All-Call interrogations or DABS interrogations. DABS squitter transmissions are also generated at random intervals to allow transponders to be acquired without interrogation.

2.2.2.2 *Reply Carrier Frequency.* The carrier frequency of the reply transmission shall be 1090 ±3 MHz.

2.2.2.2.1 *DABS Transponders.* The maximum allowed emission spectrum for a DABS Transponder shall be as described below:

Frequency difference (MHz from 1090 MHz)	Relative response (dB down from peak)
3.0	0
3.75	0
4.3	3.0
10.0	20.0
26.0	40.0
81.0	60.0

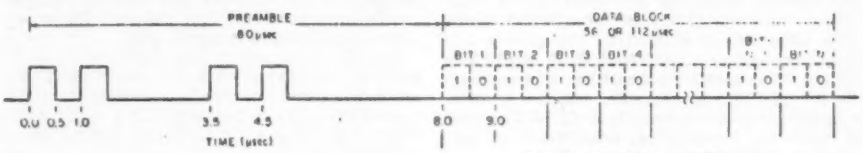
2.2.2.3 *ATCRBS Reply.* In rsponse to an ATCRBS Mode A or Mode C interrogation, a DABS transponder shall generate the appropriate Mode A or Mode C ATCRBS reply, as defined in FAA Selection Order 1010.51A. Reply pulse width, spacing, rise and decay times, and tolerances thereon are as defined in FAA Selection Order 1010.51A.

2.2.2.4 *DABS Reply Structure.* A DABS reply consists of a preamble followed by a data block containing 56 or 112 data bits. The signal format is shown in Fig. 2.2.2-1.

2.2.2.4.1 *Preamble.* The preamble consists of a series of four 0.5-μsec pulses. The intervals between the leading edge of the first preamble pulse and the leading edges of the second, third, and fourth preamble pulse shall be 1.0, 3.5, and 4.5 μsec, respectively. The pulse tolerance for the leading edge of each pulse with respect to the leading edge of the first pulse of the reply shall be ±0.05 μsec.

2.2.2.4.2 *Data Block.* The data block begins 8.0 μsec following the leading edge of the first preamble pulse. Data bits are transmitted at a 1.0 Mb/sec rate using pulse position modulation (PPM) as follows: in the 1.0-μsec interval corresponding to each data bit, a 0.5 μsec pulse is transmitted in the first half of the interval if the data bit is a 1, and in the second half of the interval if the data bit is a 0.

2.2.2.4.3 *Pulse Shape.* All reply pulses shall have a pulse duration of 0.5±0.05 μsec, except that when a 1 follows a 0 in the data block, the two 0.5-μsec pulses are contiguous, resulting in a single pulse of duration 1.0±0.05 μsec. Pulse rise time shall be less than 0.1 μsec, and pulse decay time shall be less than 0.2 μsec. The pulse amplitude variation of one pulse with respect to any other pulse in a reply train shall not exceed 2 dB.



Note: N=56 or 112

Fig. 2.2.2.-1. DABS Reply Format.

2.2.2.4.4 *Pulse Interval Tolerances.* The pulse interval tolerance for the leading edge of each pulse, with respect to the leading edge of the first preamble pulse of the reply, shall be ±0.05 μsec.

2.2.2.4.5 *Reply Delay and Jitter for DABS.* The leading edge of the first preamble pulse of the reply to a DABS interrogation shall occur at a time 128.0±0.25 μsec following the sync phase reversal of the interrogation data block. The jitter of the reply delay shall not exceed 0.05 μsec, rms.

2.2.2.4.6 *Reply Delay and Jitter for ATCRBS/DABS All-Call.* The leading edge of the first preamble pulse of the reply to an ATCRBS/DABS All-Call interrogation shall occur at a time 128.0±0.5 μsec following the leading edge of the P_4 pulse of the interrogation. The jitter of the reply delay shall not exceed 0.06 μsec, rms, for received signal levels between 3 and 50 dB above minimum triggering level.

NOTE.—A jitter of 0.06 μsec, rms is consistent with the reply jitter of ±0.1 μsec for ATCRBS replies specified in FAA Selection Order 1010.51A, paragraph 2.7.11.

2.2.3 *DABS Message Formats.*

2.2.3.1 *Interrogation and Reply Types.* There are five DABS interrogation types, and five DABS reply types, as follows:

a. Interrogation Types: DABS-Only All-Call, Surveillance (Unsynchronized or Synchronized), Comm-A, Comm-S (Synchronized), and Comm-C.

b. Reply Types: All-Call (Standard or Squitter), Surveillance (Unsynchronized, Synchronized or Special), Comm-B, Comm-T (Synchronized), and Comm-D.

In addition to the above interrogation types, a DABS Broadcast transmission is defined as a Surveillance or Comm-A interrogation with an all-zero address.

2.2.3.2 *Interrogation Types.*

2.2.3.2.1 *DABS-Only All-Call.* The DABS-Only All-Call is a short uplink interrogation which includes a data field containing a 2-bit header and a series of 30 undefined (spare) bits followed by a 24-bit parity field overlaid on the acquisition address. The first two spare bits (3,4) shall be transmitted as zeros if there is no message to be delivered by the transmission and the remaining 28 spares (bits 5–32) shall be transmitted as ones if there is no message.

NOTE.—The DABS-Only All-Call interrogation (length, 56 bits) is used for the acquisition of DABS-equipped aircraft. It is used in place of the ATCRBS/DABS All-Call interrogation when the interrogator does not desire to elicit replies from ATCRBS-equipped aircraft. When the first two bits (F and L) of the DABS data block are 1 and 0 respectively, the interrogation is uniquely defined as a DABS-Only All-Call. Bits 5–32 are transmitted as ones (when there is no message) to distinguish it from an unmodulated transmission.

2.2.3.2.1.1 *General Acquisition Address.* The general acquisition address consists of twenty-four zeros, such that the overlaid parity field is represented by its true parity value.

2.2.3.2.1.2 *Specific Acquisition Address.* The specific acquisition address consists of twenty zeros and one of 15 combinations of the last transmitted four bits of the address field (excluding the combination 0000).

NOTE.—On subtracting the parity from the address field, the transponder will find either the general acquisition address (0000 0000 0000 0000 0000 0000) or the specific acquisition address (0000 0000 0000 0000 0000 xxxx). The specific acquisition address can be set into the transponder via the specific acquisition address interface (2.3.6.1.1) and is used for incremental acquisition of aircraft by a DABS sensor.

2.2.3.2.2 *Surveillance.* The Surveillance interrogation (length, 56 bits) is the normal DABS interrogation. It is used for surveillance when no data link message is to be transmitted.

2.2.3.2.3 *Comm-A.* The Comm-A interrogation (length, 112 bits) is used for the transmission of a 56-bit ground-to-air data link message. Longer messages may be accommodated by successive interrogation-reply cycles. The Comm-A interrogation includes the bit structure of the Surveillance interrogation, and thus may be used in its place for surveillance.

2.2.3.2.4 *Comm-C.* The Comm-C interrogation (length, 112 bits) is used for the more efficient transmission of long ground-to-air data link messages. Each Comm-C interrogation includes an 80-bit message field, and up to 16 Comm-C interrogations may be transmitted in a single burst and acknowledged with a single transponder reply. A Comm-C interrogation cannot be used for a surveillance update because any response thereto do not contain altitude information.

2.2.3.2.5 *Synchronized Surveillance.* The Synchronized Surveillance interrogation is timed to allow passive air-to-air ranging between DABS-equipped aircraft. Synchronized interrogations include an EP field to indicate the relative time of transmission. The transponder replies to a Synchronized Surveillance interrogation with a Synchronized Surveillance reply (2.2.3.3.6).

2.2.3.2.6 *Comm-S.* The Comm-S interrogation (length, 112 bits) is used to transmit a specialized synchronized message to the aircraft. The first 32 bits of the Comm-S have the structure of the Synchronized Surveillance interrogation while the message field (SF) in bits 33 through 88 contains additional data. The transponder replies to a Comm-S interrogation with a Comm-T reply (2.2.3.3.7).

2.2.3.2.7 *DABS Broadcast Transmission.* The DABS interrogation formats can also be used in a non selective mode to broadcast data to DABS-equipped aircraft. Upon decoding a Surveillance or Comm-A interrogation with an address of all zeros, the transponder transfers the contents of the uplink data block to the appropriate display or message interface, but does neither reply to this interrogation nor respond to the control fields therein.

2.2.3.3 *Reply Types.*

2.2.3.3.1 *All-Call.*

2.2.3.3.1.1 *Standard.* The Standard All-Call reply (length, 56 bits) is used in response to an ATCRBS/DABS All-Call or a DABS-Only All-Call interrogation.

NOTE.—Its function is to inform the interrogator of the presence of a DABS-equipped aircraft within its area of coverage. It includes the aircraft's discrete 24-bit address code transmitted as part of its data field so that the interrogator can add the aircraft to its DABS roll-call and discretely address subsequent interrogations to the aircraft. In addition, it includes a Capability (CA) field to designate the data link input/output capability of the aircraft. The All-Call reply is parity protected, but does not include an address overlaid on the parity bits.

2.2.3.3.1.2 *Squitter.* The Squitter is identical to a Standard All-Call reply with the exception that the All-Call Capability field (see 2.2.3.4.2.1) is replaced by a 6-bit Altitude (AT) (2.2.3.4.2.2) field and the RT code is binary 11.

2.2.3.3.2 *Surveillance.* The Surveillance reply (length, 56 bits) is the normal DABS reply when the air-to-ground data-link transmission is not required.

NOTE.—This reply can contain, in a special field, either the aircraft's pressure altitude encoded as in ATCRBS Mode C replies or the ATCRBS identity (4096) code. The choice is commanded by the interrogator and normally the interrogator's transmission requests altitude information. The aircraft can signal to the interrogator that 4096 readout is desired and on receipt of this signal the interrogator can sample the 4096 code.

2.2.3.3.3 *Special Surveillance.* The Special Surveillance reply is a type of (Unsynchronized) Surveillance reply in which all class X (2.2.3.4) data fields are available as special data bits.

2.2.3.3.4 *Comm-B.* The Comm-B reply (length, 112 bits) is used for the transmission of an air-to-ground data link message. The Comm-B reply includes the bit pattern of the (Unsynchronized) Surveillance reply, and thus may be used in its place for a surveillance update.

NOTE.—Comm-B transmissions may be squittered by ground transponders. Special addresses will be reserved for these transponders (see 2.2.3.4.4.10).

2.2.3.3.5 *Comm-D.* The Comm-D reply (length, 112 bits) is used for the efficient transmission of long air-to-ground data link messages. Each Comm-D reply includes an 80-bit message field; and up to 16 Comm-D replies may be transmitted as a single long response, and acknowledged with a single interrogation.

2.2.3.3.6 *Synchronized Surveillance.* The Synchronized Surveillance reply contains a replica of the timing field (EP) of the corresponding synchronous interrogation.

2.2.3.3.7 *Comm-T.* The Comm-T reply (length, 112 bits) is used for the transmission of a synchronized data link message. The transponder generates this reply on receipt of a Comm-S interrogation.

2.2.3.4 *Data Block Formats and Field Classification.* The data block formats for each interrogation and reply type are shown in Fig. 2.2.3–1. Table 2.2.3–1 lists for each field its location in either interrogation or reply together with the field classification and the descriptive paragraph within this standard. A detailed description of the use of the control fields for implementing the extended length message functions is included in 2.2.5. The fields defined in these data blocks are divided into six types:

a. General Fields (2.2.3.4.1).

b. Standard All-Call and Squitter Reply Fields (2.2.3.4.2).

c. Surveillance/Comm-A/Comm-S Interrogation Fields (2.2.3.4.3).

d. Surveillance/Comm-B/Comm-T Reply Fields (2.2.3.4.4).

e. Special Comm-C/Comm-D Fields (2.2.3.4.5).

f. Special Surveillance Reply Fields (2.2.3.4.6).

The fields are further classified according to their effect on transponder operation; there are four classes:

1. Class I fields affect transponder operation directly, or are affected by the transponder.

2. Class IE fields are class I only when ELM capability is provided in the transponder.

3. Class IS fields apply only during synchronous operation.

4. Class X fields pass through the transponder in either direction and do not affect transponder operation nor are they affected by it. When ELM and/or synchronous operation are not employed, the IE and IS fields become class X.

2.2.3.4.1 *General Fields.*

2.2.3.4.1.1 *F: (Format), Uplink Format Type.* This is a class I field. The first bit of the uplink data block designates the format type transmitted:

F Bit, and Uplink Format Type

0—Normal (surveillance, Comm-A, Comm-S formats).

1—Special (DABS-only All-Call, Comm-C formats).

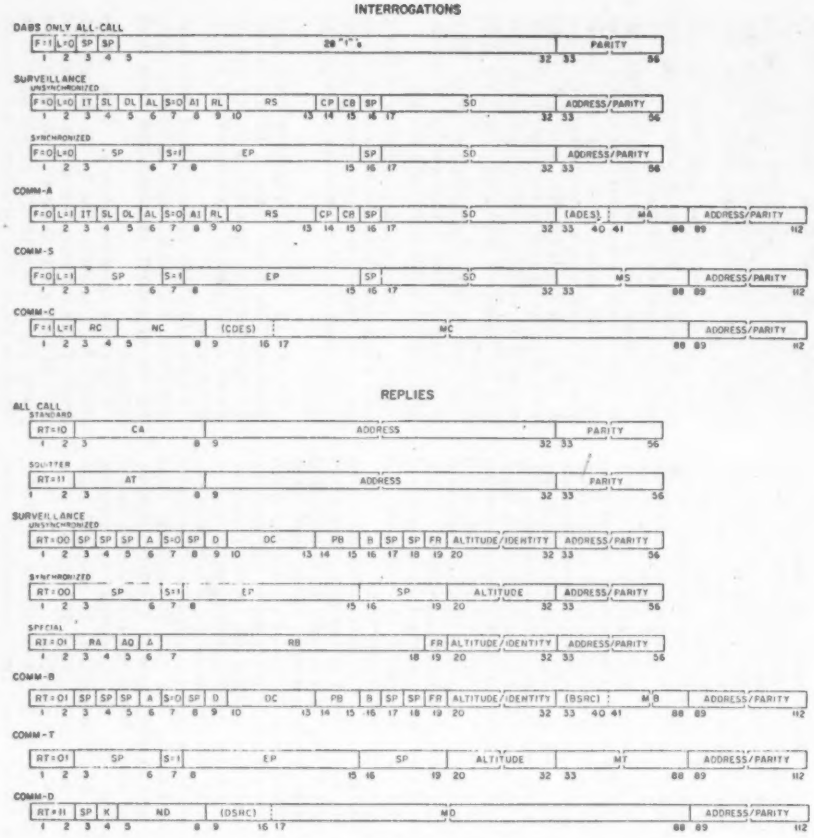


Fig. 2.2.3-1. DABS Interrogation and Reply Data Formats.

Table 2.2.3-1. Field Abbreviations.

Abbrev.	Name	Bit Number Interrog.	Bit Number Reply	Class	Reference Paragraph
A	Alert	-	6	I	2.2.3.4.4.1
ADES	Message Type/Destination	33-40	-	X	2.2.3.4.3.12
-	Address	-	9-32	I	2.2.3.4.2.3
-	Address/Parity	33-56,89-112		I	2.2.3.4.3.14
-	Address/Parity	33-56,89-112		I	2.2.3.4.4.14
AI	Altitude/Identity Flag	8	-	I	2.2.3.4.3.5
AL	ATCRBS Lockout	6	-	I	2.2.3.4.3.3
-	Altitude/Identity Field	-	20-32	I	2.2.3.4.4.9
AQ	Acquisition Flag	-	5	I	2.2.3.4.6.1
AT	Truncated Altitude	-	3-8	I	2.2.3.4.2.2
B	Comm-B Message Waiting	-	16	X	2.2.3.4.4.7
BSRC	Message Type/Source	-	33-40	X	2.2.3.4.4.10
CA	Capability	-	3-8	X	2.2.3.4.2.1
CB	Clear Comm-B	15	-	X	2.2.3.4.3.10
CDES	Message Type/Destination	9-16	-	IE	2.2.3.4.5.2
CP	Clear PB	14	-	X	2.2.3.4.3.9
D	Comm-D Message Waiting	-	9	IE	2.2.3.4.4.3
DC	Length of Reply ELM	-	10-13	IE	2.2.3.4.4.4
DL	DABS Lockout	5	-	I	2.2.3.4.3.2
DSRC	Message Type/Source	-	9-16	IE	2.2.3.4.5.3
EP	Synchronous Time	8-15	-	IS	2.2.3.4.3.8
EP	Synchronous Time	-	8-15	IS	2.2.3.4.4.5
F	Format Type	1	-	I	2.2.3.4.1.1
FR	Flight Rules Indicator	-	19	X	2.2.3.4.4.8
IT	Interrogator Type	3	-	I	2.2.3.4.1.3
K	ELM Control Indicator	-	4	IE	2.2.3.4.5.3
L	Data-Block Length	2	-	I	2.2.3.4.1.2
MA	Interrogation Data	33-88	-	X	2.2.3.4.3.12
MB	Reply Data	-	33-88	X	2.2.3.4.4.10
MC	Interrogation ELM Segment	9-88	-	IE	2.2.3.4.5.2
MD	Reply ELM Segment	-	9-88	IE	2.2.3.4.5.3
MS	Synchr Interrogation Data	33-88	-	IS	2.2.3.4.3.13
MX	Maximum Airspeed	-	11-13	I	2.2.3.4.6.2
MT	Synchronized Reply Data	-	33-88	IS	2.2.3.4.4.11
NC	Interrog ELM Segment No	5-8	-	IE	2.2.3.4.5.2
ND	Reply ELM Segment No	-	5-8	IE	2.2.3.4.5.3
-	Parity	33-56	-	I	2.2.3.2.1
-	Parity	-	33-56	I	2.2.3.4.2.4
PB	Pilot Acknowledgement	-	14-15	X	2.2.3.4.4.6
RA&RB	Special Surveillance Data	-	3-4,7-18	X	2.2.3.4.6.3
RC	Reply Type for Comm-C	3-4	-	IE	2.2.3.4.5.1
RL	Reply Length	9	-	I	2.2.3.4.3.6
RS	Reply Selector	10-13	-	I	2.2.3.4.3.7
RT	Reply Type	-	1-2	I	2.2.3.4.1.4
S	Synchronization Indicator	7	-	I	2.2.3.4.3.4
S	Synchronization Indicator	-	7	I	2.2.3.4.4.2
SD	Surveillance Data	17-32	-	X	2.2.3.4.3.11
SL	Squitter Lockout	4	-	I	2.2.3.4.3.1
SP	Spare	3,4,16	3-5,8,17-18	X	-
SR	Segment Request	9-24	-	IE	2.2.3.4.5.2
TA	Transponder Technical Acknowledgement	-	9-24	IE	2.2.3.4.5.3

2.2.3.4.1.2 *L: Length of Uplink Block.* This is a class I field. The second bit of the uplink data block designates the block length transmitted:

L Bit, and Length

0—56 bits.
1—112 bits.

2.2.3.4.1.3 *IT: Interrogator Type.* This one-bit, class I field designates whether the interrogation is transmitted from a standard (IT=1) or auxiliary (IT=0) interrogator.

NOTE.—A standard interrogator is defined as a DABS sensor with a directional antenna performing normal ATC surveillance and communications, while an auxiliary interrogator is an omnidirectional air-to-air or ground-to-air interrogator.

2.2.3.4.1.4 *RT: Reply Type.* This two-bit, class I, field designates the format of the DABS reply as follows:

RT, and Reply Type

0 0—Surveillance.
0 1—Comm-B, Comm-T, or Special Surveillance.
1 0—Standard All-Call.
1 1—Comm-D or Squitter.

NOTE.—The 01 and 11 codes are each used to designate more than one reply format. This lack of uniquencess does not result in ambiguity because the reply length and the Synchronization indicator S (2.2.3.4.4.2) further define the reply type. The RT field is not required to indicate to the decoder the length of the reply. The RT field is used primarily for distinguishing between Squitters and Standard All-Call replies.

2.2.3.4.2 *Standard All-Call and Squitter Reply Fields.*

2.2.3.4.2.1 *CA: Capability.* This six-bit field is class X, except for bit No. 8 which is class IE. Bits 3 through 7 are to be assigned to specific I/O capabilities and when set to one indicate the presence of such devices in the aircraft's installation. Bit 8 when set equal one designates that the installation is equipped with extended capability reporting (2.2.3.4.4.12).

2.2.3.4.2.2. *AT: Altitude, Truncated for Squitter Transmissions.* This is a class I field. The special 6-bit altitude code is a truncated version of the full ATCRBS Mode C altitude code and provides digitized altitude in 1000-ft increments quantized to ±500 feet from −750 feet to +62,250 feet, as follows:

Bit Number: / Pulse Position:	3 A_1	4 A_2	5 A_4	6 B_1	7 B_2	8 D_4	Altitude Range (feet)	Average Altitude (feet)
Minimum Altitude	0	0	0	0	0	0	-1250 to -250	-750
First step	0	0	0	0	1	0	-250 to +750	250
Second step	0	0	0	1	1	0	+750 to +1750	1250
.								
.								
.								
Maximum altitude	0	0	0	0	0	1	+61750 to +62750	62250

NOTE.—Because of the altitude digitizer coding, an aircraft at an altitude above 62,750 ft will squitter a code which will indicate an altitude below 62,750 ft. However, the AT code is intended only to provide a preliminary indication of altitude to allow minimization of acquisition interrogation rates in high aircraft-population density airspace. After the target is acquired by a discrete interrogation, the full altitude code will be available. Since the aircraft population density above 62,750 ft will always be relatively low, it is not necessary to increase the unambiguous range of the AT code to provide for higher altitudes.

2.2.3.4.2.3 *Address.* This 24-bit, class I field contains the aircraft's discrete address code.

2.2.3.4.2.4 *Parity.* This 24-bit, class I field contains 24 parity check bits generated by applying a parity check code to the preceding bits in the data block. The algorithms for generating the parity check bits are described in 2.2.4.

2.2.3.4.3 *Surveillance/Comm-A/Comm-S Interrogation Fields.*

2.2.3.4.3.1 *SL: Squitter Lockout.* This one-bit class I field allows the interrogator to prevent the transponder from transmitting Squitters and from accepting auxiliary discrete address interrogations (i.e., interrogations with IT=0; see 2.2.3.4.1.3). Each time the transponder replies to a discrete interrogation containing SL=1, the transponder shall be immediately locked out to Squitters and auxiliary discrete interrogations for a period of T_{SL} seconds and a time-out shall be initiated (or reinitiated) for the full T_{SL} interval. The transponder shall generate Squitters and accept auxiliary discrete interrogations only if it has not replied to an interrogation with SL=1 within T_{SL} seconds. When an interrogation is received with SL=0, the lockout state and the T_{SL} time-out shall not be affected.

2.2.3.4.3.2 *DL: DABS Lockout.* This one-bit, class I field allows the interrogator to prevent the transponder from accepting ATCRBS/DABS All-Calls and DABS-Only All-Calls with specific acquisition addresses. (This field does not affect acceptance of ordinary ATCRBS interrogations or DABS-Only All-Calls with the general (all-zero) acquisition address.) Each time the transponder replies to a discrete interrogation containing DL=1, the transponder shall be immediately locked out to the appropriate All-Calls for a period of T_{DL} seconds and a time-out shall be initiated (or reinitiated) for the full T_{DL} interval. The transponder shall accept All-Calls only if it has not replied to an interrogation with DL=1 within T_{DL} seconds. When an interrogation is received with DL=0. the lockout state and the T_{DL} time-out shall not be affected.

2.2.3.4.3.3 *AL: ATCRBS Lockout.* This one-bit, class I field allows the interrogator to prevent the transponder from accepting ATCRBS interrogations. (This field does not affect acceptance of All-Calls.) Each time the transponder replies to a discrete interrogation containing AL=1, the transponder shall be immediately locked out to ATCRBS interrogations for a period of T_{AL} seconds and a time-out shall be initiated (or reinitiated) for the full T_{AL} interval. The transponder shall accept ATCRBS interrogations only if it has not replied to an interrogation with AL=1 within T_{AL} seconds. When an interrogation is received with AL=0, the lockout state and the T_{AL} time-out shall not be affected.

2.2.3.4.3.4 *S: Synchronization Indicator.* This one-bit class I field designates whether or not the interrogation is synchronized, i.e., timed such that the resulting reply occurs at a known time. A one in this field indicates that the interrogation is synchronized and requires that bits 8–15 be interpreted as EP (see 2.2.3.4.3.8).

2.2.3.4.3.5 *AI: Altitude/Identity Designator.* This one-bit class I field is used to designate whether the reply is to contain the pressure altitude code or the ATCRBS identity code in its Altitude/Identity field. A one shall be used to request transmission of the ATCRBS identity code.

2.2.3.4.3.6 *RL: Reply Length.* This one-bit class I field is used in interrogations to designate the reply type (length) as follows:

RL Bit, and Reply Type

0—Surveillance (56 bits)
1—Comm-B (112 bits)

If the RL bit is a one, the transponder shall transmit a Comm-B reply regardless of whether or not there is a Comm-B device attached. The RL bit also determines the definition of the RS code (see 2.2.3.4.3.7).

2.2.3.4.3.7 *RS: Reply Selector.* This four-bit class I field is used in conjunction with the RL code in unsynchronous interrogations to specify the format and source of data to be transmitted in DABS replies. When an interrogation is received with S=0, RL=0, and RS=0000, a Surveillance reply shall be transmitted. When S=0, RL=0 and RS=0000, a Special Surveillance reply shall be transmitted. (Particular Special Surveillance reply codes are specified in 2.2.3.4.6.) When RL=1, the RS field specifies the source of the MB data in the Comm-B reply as follows: RS=0000 designates a message of unknown source announced by transmission of the B-bit in a previous reply. RS=0001 designates an extended capability report (see 2.2.3.4.4.12).

2.2.3.4.3.8 *EP (EPOCH): Synchronous Reply Time.* This eight-bit class IS field designates the synchronized reply time (see 2.2.3.4.4.5).

2.2.3.4.3.9 *CP: Clear PB.* This one-bit class X field is reserved to acknowledge and reset pilot acknowledgments.

2.2.3.4.3.10 *CB: Clear Comm-B.* This one-bit field is used to acknowledge receipt of an air-to-ground Comm-B message. A one in this field indicates acknowledgment. When an interrogation is received with CB=1, the B bit shall be cleared in the reply to that interrogation unless another Comm-B message is waiting; in that case, the B bit shall remain set.

2.2.3.4.3.11 *SD: Surveillance Data.* This 16-bit class X field is reserved for transmission of short, specialized data words.

NOTE.—A 12-bit class X subfield of SD is used when bits 17-20 are all zeros to transmit to the aircraft its true corrected altitude as reported on the previous transponder reply.

2.2.3.4.3.12 *MA: Interrogation Data Link Message.* This 56-bit class X field contains the interrogation data-link message and includes ADES, the MA message type and/or destination.

2.2.3.4.3.13 *MS: Synchronized Interrogation Data.* This 56 bit class IS field contains the interrogation synchronized data link message.

2.2.3.4.3.14 *Address/Parity.* This 24-bit class I field contains the 24-bit discrete address of the interrogated aircraft combined with 24 parity bits generated by applying a parity check code to the preceding bits in the data block. The algorithms for generat-

ing the parity check bits and their combination with the address code are described in 2.2.4 (also see 2.2.3.4.4.14).

2.2.3.4.4 *Surveillance/Comm-B/Comm-T Reply Fields.*

2.2.3.4.4.1 *A: Alert.* This one-bit class I field alerts the sensor to changes in the ATCRBS identity (4096) code setting and to emergencies. The A bit shall be automatically set each time the 4096 code setting is changed. Upon receipt of the next DABS Surveillance or Comm-A interrogation, the transponder shall reply with A=1. The A bit shall be reset to zero in a reply containing the 4096 code transmitted in response to an interrogation with IT=1 and AI=1, with the following exception: the transponder shall transmit the A bit continuously when the 4096 code indicates an emergency condition (7700 or 7600), and shall not be reset to zero upon receipt of AI=1 from the ground.

2.2.3.4.4.2 *S: Synchronization Indicator.* This one-bit class IS field echoes the S bit of the corresponding interrogation (see 2.2.3.4.3.4), indicating (by S=1) that the reply is synchronized.

2.2.3.4.4.3 *D: Extended-Length "Message Waiting" Indicator.* This one-bit class IE field designates to the interrogator that the transponder has an extended-length message waiting to be transmitted. A one in this field indicates the presence of such a message.

2.2.3.4.4.4 *DC: D-Count.* This four-bit class IE field is used to indicate the length of an extended-length message waiting to be sent. The four-bit binary integer in DC is one less than the number of segments in the extended-length message. The first bit transmitted in this field shall be the most significant bit.

2.2.3.4.4.5 *EP: EPOCH, Synchronous Reply Time.* This eight-bit class IS field repeats, in a synchronized reply, the contents of the EP field in the corresponding synchronized interrogation (see 2.2.3.4.3.8).

2.2.3.4.4.6 *PB: Pilot Acknowledgement.* This two-bit class X field is reserved for a pilot acknowledgement code.

2.2.3.4.4.7 *B: Data Link "Message Waiting" Indicator.* This class X field is reserved for designating to the interrogator that the aircraft has a Comm-B message waiting to be transmitted.

2.2.3.4.4.8 *FR: Flight Rules Indicator.* This one-bit class X field is reserved for indicating whether the aircraft is operating under visual or instrument flight rules.

2.2.3.4.4.9 *Altitude/Identity.* This 13-bit class I field contains the ATCRBS Mode A identity code or Mode C altitude code (including the X bit), as requested by the AI field in the corresponding interrogation. The sequence of the code pulses shall be as specified in FAA Selection Order 1010.51A, paragraph 2.6.2.

2.2.3.4.4.10 *MB: Reply Data Link Message.* This 56-bit class X field contains the data link message and includes BSRC, the MB message type and/or source. If a Comm-B reply is transmitted for which no data are available, the MB field shall contain all zeros.

NOTE.—The BSRC field may be used to identify ground transponders emitting Comm-B squitter transmissions (see 2.2.3.3.4).

2.2.3.4.4.11 *MT: Synchronized Reply Data.* This 56-bit class IS field contains the synchronized reply data. If a Comm-T reply is transmitted for which the transponder and/or its peripherals cannot supply data, the MT field shall contain all zeros.

2.2.3.4.4.12 *Extended Capability and Flight Number Reply.* In response to a correctly addressed interrogation with RL=1 and RS=0001 (see 2.2.3.4.3.7), the transponder shall transmit a Comm-B reply whose MB field (class X) is reserved for extended capability and aircraft flight number codes. The specific codes are not yet defined, except as indicated in 2.2.3.4.4.13.

2.2.3.4.4.13 *ELM Capability Code.* If the transponder is ELM equipped and has an operational ELM input/output device, bit position 41 shall be transmitted as a one to indicate ELM capability in response to an interrogation with RL=1 and RS=0001. All remaining bits of the transmitted MB class X field shall be zeros unless ones are automatically entered in preassigned bit positions by I/O devices.

2.2.3.4.4.14 *Address/Parity.* This 24-bit class I field contains the 24-bit discrete address of the replying aircraft combined with 24 parity check bits generated by applying a parity check code to the preceding bits in the data block. The algorithms for generating the parity check bits and their combination with the address code are described in 2.2.4.

2.2.3.4.5 *Special Comm-C/Comm-D Fields.* All fields described in this section are class IE. In each numerical field the first bit transmitted shall be most significant bit.

2.2.3.4.5.1 *RC: Reply Type for Comm-C Interrogations.* This special two-bit reply type and control field is used in conjunction with an extended-length message transmission. The RC codes are defined in Table 2.2.3-2.

2.2.3.4.5.2 *NC and MC.* Respectively, these four-bit segment number and 80-bit message fields are included in Comm-C transmissions. The interpretation of these fields is determined by the RC code, as defined in Table 2.2.3-2.

2.2.3.4.5.3 *K, ND, MD (including TA).* Respectively, these 1-bit, 4-bit and 80-bit, (including the 16 bit TA) Comm-D fields are used for extended-length message transfer as follows:

K Bit, ND Bits and MD Bits

0 segment number of message segment in MD, 80-bit segment of reply, extended-length message (the zeroth segment includes DSRC, the MD message type and/or source).

1 not used (all zeros), 16-bit cumulative transponder technical acknowledgment (TA) of interrogation extended-length message (bit positions 9 to 24).

If the interrogation transmission requests a Comm-D reply and the transponder is ELM-equipped, the transponder shall transmit a Comm-D reply regardless of whether or not there are ELM data available. If a Comm-D reply is transmitted for which the transponder and/or the ELM device cannot supply data, the MD field shall contain all zeros. If the interrogation transmission requests a Comm-D reply from a transponder which is not ELM-equipped, the transponder shall not reply.

2.2.3.4.6 *Special Surveillance Reply Fields.* Upon receipt of an interrogation with S=0, RL=0 and RS=0000, the transponder shall transmit a Special Surveillance reply including the following class I internally generated fields to assure cooperation with air-to-air auxiliary interrogators.

2.2.3.4.6.1 *AQ: Acquisition Flag.* Upon receipt of an interrogation with RL=0 and RS=xxlx (where x designates either a one or a zero), bit 5 (AQ) of the Special Surveillance reply shall be transmitted as a one, indicating an acquisition reply. When RL=0 and RS=xx0x, but RS=0000, bit 5 shall be transmitted as a zero, indicating a roll call reply.

2.2.3.4.6.2 *MX: Maximum Airspeed Field.* On receipt of an interrogation with RL=0 and RS=0010, bit positions 11 to 13 (located in the RB field) of the reply shall contain the maximum airspeed code for the aircraft. MX indicates the maximum cruising airspeed of the aircraft in which the transponder is installed. The coding of this field is as follows:

Table 2.2.3-2. Definition of Comm-C Fields.

RC	NC	MC	Reply	Function of Comm-C Transmission
0 0	0 0 0 1 to 1 1 1 1	Initial 80-bit Message Segment	No Reply	Contains highest-number segment of uplink ELM (includes CDES, the MC message type and/or destination) and indicates number of segments to follow
0 1	0 0 0 1 to 1 1 1 0	Intermediate 80-bit Message Segment	No Reply	Contains an intermediate segment of an uplink ELM and its segment number
1 0	0 0 0 0 to 1 1 1 0	Final 80-bit Message Segment	Comm-D with K=1 and TA in MD	Contains last segment of uplink ELM and requests cumulative Transponder Technical Acknowledgement (TA)
1 1	0 0 0 0	Segment Request (SR) Field (16 bits)	Multiple Comm-D transmissions	Specifies which downlink ELM segments the transponder should transmit
1 1	0 0 0 1	Bit 9 (first bit of MC) = 1, others = 0	Single Comm-D, contents arbitrary	Concludes an uplink ELM transaction
1 1	0 0 1 0	Bit 9 (first bit of MC) = 1, others = 0	Single Comm-D, contents arbitrary	Concludes a downlink ELM transaction
1 1	0 0 1 1 to 1 1 1 1	---	---	Undefined

MX Bit No. 11 12 13	Maximum Airspeed
0 0 0	No input
0 0 1	Not yet defined
0 1 0	
0 1 1	
1 0 0	
1 0 1	
1 1 0	
1 1 1	Squitters inhibited

The MX=111 code shall be automatically set whenever the Squitter Inhibit interface (see 2.3.6.4) is activated.

NOTE.—This airspeed information is used in scheduling reacquisition interrogations if the transponder is outside the range of interest of the auxiliary interrogator. The absence of an airspeed code results in a default to the all-zeros code. The Squitter Inhibit interface may be used to encode all ones in this field when the aircraft is on the ground so that the aircraft may be so identified.

2.2.3.4.6.3 *RA and RB: Special Surveillance Reply Data.* Bits 3, 4, and 7-18 of the Special Surveillance reply, with the exception of the MX code bits (11-13) form a class X field, and shall be obtained from the digital interface (see 2.3.1.2) and shall not be acted upon by the transponder. In the absence of inputs from the interface, all externally-derived bits shall be transmitted as zeros.

2.2.4 *Error Protection.*

2.2.4.1 *Technique.* Parity check coding is used on DABS interrogations and replies to provide protection against the occurrence of errors.

2.2.4.1.1 *Parity Check Sequence.* A sequence of 24 parity check bits is generated by a code described in 2.2.4.1.2 and is incorporated into the field formed by the last 24 bits of any DABS transmission. In DABS-Only All-Call interrogations, in All-Call replies and in Squitters this sequence of 24 parity check bits forms the parity check field directly. In all other DABS transmissions the 24 parity check bits are combined with the discrete address as described in 2.2.4.3. The combination of discrete address and parity check bits then forms the Address/Parity field.

2.2.4.1.2 *Parity Check Sequence Generation.* The sequence of 24 parity bits (P_1, P_2, . . . P_{24}) is generated from the sequence of information bits m_1, m_2 . . . m_k) as they are shown in Fig. 2.2.3-1 where k is 32 or 88 for short or long transmissions respectively. This is done by means of a code which is generated by the polynomial

$$G(x) = \sum_{i=0}^{24} g_i x^i$$

where $g_i = \begin{cases} 1 \text{ for } i = 0, 3, 10, \text{ and } 12 \text{ through } 24 \\ 0 \text{ otherwise} \end{cases}$

When by the application of binary polynomial algebra the above G(x) is divided into the information sequence expressed as

$$M(x) = m_k + m_{k-1}x + m_{k-2}x^2 + \ldots + m_1 x^{k-1}$$

the result will be a quotient and a remainder R(x) of degree <24. The bit sequence formed by this remainder represents the parity check sequence. Parity bit P_i, for any i from 1 to 24, is the coefficient of x^{24-i} in R(x).

2.2.4.2 *Parity Field Generation.* The parity check bits described in 2.2.4.1.2 will be transmitted as the last 24 bits of the DABS transmission in the sequence

$P_1, P_2 \ldots P_{24}$.

2.2.4.3 *Address/Parity Field Generation.* The address is formed by a sequence of 24 bits, (a_1, a_2 . . . a_{24}) where a_i is the bit transmitted first in an All-Call reply. This address sequence is used in the downlink Address/Parity field generation, while a modified form of this sequence (b_1, b_2 . . . b_{24}) is required for uplink Address/Parity field generation.

Bit b_i is the coefficient of x^{i-1} in the polynomial H(x)A(x), where

$$A(x) = a_1 + a_2 x + a_3 x^2 + \ldots + a_{24} x^{23}$$

and

$$H(x) = \sum_{i=0}^{24} g_i x^{24-i}$$

The sequence of bits transmitted in the Address/Parity field is

$t_{k+1}, t_{k+2} \ldots t_{k+24}$

if the bits are numbered as in Fig. 2.2.3.-1.

2.2.4.3.1 *Uplink Field.* In uplink transmissions

$t_{k+i} = b_i + p_i$

where " + " prescribes modulo-2 addition.

2.2.4.3.2 *Downlink Field.* In downlink transmissions.

$t_{k+i} = a_i \oplus p_i$

where "$\oplus$" prescribes modulo-2 addition.

2.2.5 *Comm-C/Comm-D Extended-Length Message Protocol.* The extended-length message (ELM) protocol provides for efficient transmission of long data link messages by permitting the grouping of up to 16 message segments into a single entity which can be acknowledged by a single reply. Each single segment is included in a Comm-C or Comm-D transmission. (The limit of 16 segments refers solely to the manner in which the message is transferred over the link. Longer messages can be accommodated through the use of message continuation indicators within the text of the ELM.)

2.2.5.1 *Ground-to-Air ELM Transfer.* Ground-to-air extended-length messages are transmitted using the Comm-C format with three different reply type codes (RC=00, 01 and 10). The three reply type codes designate an initializing segment, intermediate segments and a final segment. The minimum length of a ground-to-air ELM is two segments. The transfer of all segments may take place without intervening replies. Comm-C transmissions shall follow each other in intervals of no less than 50 μsec. (This minimum spacing is required to permit the resuppression of ATCRBS transponders.)

2.2.5.1.1 *Initializing Segment Transfer.* The ELM transactions for an N-segment message (segment numbers 0 through N-1) is initiated by a Comm-C interrogation with RC=00. The transponder does not reply. Receipt of this interrogation (in effect a "dial up") causes the airborne ELM equipment to prepare for a new ELM transfer. Also delivered in the initial call is the text of the final message segment in MC, and its segment number (N-1) in the NC field.

NOTE.—This "last segment first" protocol is used to inform the transponder of the length of the message. If the ELM processor fails to receive an initializing segment, it may either ignore or store the data content of all further segments of the same message since the interrogator will retransmit the entire message (see 2.2.5.1.4), initializing segment and all other segments, without change.

2.2.5.1.2. *Intermediate Segment Transfers.* Message delivery proceeds with the transmission of intermediate segments (any sequence of N-2 segments chosen from segments N-2 through 1) via Comm-C interrogations with RC=01, again triggering no replies. Each message segment is identified with its segment number in the NC field. The ELM processor stores each segment in the appropriate storage location based upon this number. In this way, the message processor reassembles the message, and its bookkeeping function keeps track of which segments have been received.

NOTE.—Intermediate segments may be delivered in any order, once the ELM processor has been initialized with segment N-1. If the entire message consists of only two segments, there will be no intermediate transfers.

2.2.5.1.3 *Final Segment Transfer.* The interrogator transmits the final segment of a Comm-C interrogation with RC=10. Its segment number (any number from 0 to N-2) is in NC, and the text is transmitted in MC. This RC code elicits a Comm-D reply with K=1 and a cumulative Transponder Technical Acknowledgement in the MD field. The cumulative Transponder Technical Acknowledgement (TA) consists of a bit string (maximum length 16 bits) which indicates which segments of the ELM have been received. The first bit represents the state of the first (N=0) segment, etc., with the states defined as: 1=segment received, and 0=segment not received. (The remaining 64 bits of MD are spares and shall be transmitted as zeros). Thus at all times this field represents the current status of segment delivery from the time of ELM initiation. If the interrogator does not receive a reply to the Comm-C interrogation containing the final segment, this interrogation is repeated until a reply is successfully received. When all segments have been received by the transponder, the interrogator knows that its last transfer was indeed final and closes out the transaction by the transmission of a special Comm-C interrogation with RC=11, NC=0001 and bit 9=1, thereby resetting the TA field and any other bookkeeping registers in the transponder. This "Clear Comm-C" interrogation elicits a single Comm-D reply (with arbitrary message content) which serves as a technical acknowledgement to the interrogator. To expedite the display of the message, the ELM processor in the transponder transfers the message to the appropriate output device as soon as it senses the presence of all segments (i.e., it does not await the receipt of the Clear Comm-C interrogation). However, output transfer shall be enabled only once for each ground-to-air ELM message to avoid displaying the same message more than once in the event of retransmission due to TA delivery failure.

NOTE.—The interrogator will always send a Clear Comm-C message after partial delivery of an ELM which it wishes to cancel, as well as after normal complete delivery. This

procedure ensures that there will be no confusion between segments of successive ELM's, even if the initializing segment of the second ELM is subject to link failure.

2.2.5.1.4 *Segments not Received by Transponder.* If one or more segments of the ELM are not received by the transponder, this fact is indicated by zeros in the corresponding bit positions in the TA. If the TA indicates that the initializing segment was not received, the interrogator retransmits the entire message. If segments other than the initializing segment are missing, they are retransmitted with RC=01, except for the last of the missing segments which has RC=10 to request an updated TA. This process continues until the ground receives a cumulative TA indicating that all segments have been delivered. At that point, the transaction is closed out as described above. If standard DABS contact is lost (i.e., if more than nominally 16 seconds has elapsed since the transponder last replied to a discrete address interrogation with IT=1) before a ground-to-air transaction is closed out, the transaction shall be abandoned.

2.2.5.2 *Air-to-Ground ELM Transfer.* The transfer of an air-to-ground ELM is similar to the ground-to-air process. Differences between the two protocols result primarily from the facts that (1) all channel activity is ground initiated and (2) the transponder can reply with a longer communications format only when given specific permission by the ground. Comm-D transmissions shall follow each other in intervals of 136±1 μsec.

2.2.5.2.1 *Initialization.* An N-segment air-to-ground ELM transfer is initiated by a non-synchronized Surveillance or Comm-B reply containing the D bit set to 1, and DC set to N-1. The interrogator is fully initialized as soon as it receives this information.

2.2.5.2.2. *Transmission.* The interrogator requests the air-to-ground transmission of ELM segments using a single Comm-C transmission with RC=11. In this format, the NC field contains all zeros and the first 16 bits of MC form a special 16-bit Segment Request (SR) field, in which the successive bit positions correspond to segment numbers 0 through 15. (The remaining 64 bits of MC are spares and shall be transmitted as zeros). The designated response is a series of Comm-D replies with K=0 containing those message segments for which the corresponding SR bit is set to one. (The transponder thus is not told which segments have been successfully received, but those which are to be transmitted.) After the complete response to the Comm-C interrogation has been received, another Comm-C interrogation with RC=11, NC=0000 and an updated SR field is transmitted to request segments not yet received (either because they were not requested in the first response, or because they were received in error). The transponder replies again with the requested segments. The cycle is repeated until all segments have been received.

NOTE.—This process corresponds to the process described in 2.2.5.1. Although the precise spacing of segments in the response is known to the interrogator, each segment is transmitted as a full Comm-D reply with a preamble to resynchronize the reply decoder in case the preceding segment is lost.

2.2.5.2.3 *Termination.* The transaction is terminated by a special Comm-C interrogation with RC=11, NC=0010, and bit 9=1. This interrogation resets the D-bit and DC field. It also elicits a single Comm-D reply (with arbitrary contents in the MD field) which serves as a technical acknowledgement to the interrogator.

NOTE.—The ground processor, which has control of message traffic, services ground-to-air messages in the order received except when a user-supplied priority tag indicates otherwise. The existence of a small number of priority message classes permits, for example, an urgent command to move ahead of other waiting messages. For air-to-ground messages, the possible priority classes are more limited, since there is less advance knowledge of the message parameters. However, ELM transfers are generally regarded as having lower priority than Comm-A or Comm-B messages. Delivery of a ground-to-air ELM can be interrupted at any time to permit the delivery of an urgent Comm-A message, and then resumed. Similarly, a Comm-B message can interrupt an air-to-ground ELM. Message numbering (as opposed to segment numbering) in not required for this protocol; if desired by the user, message IDs may be coded within the messaage text.

2.3 *Transponder Characteristics.*

2.3.1 *Transponder ATCRBS Performance.* The transponder shall meet all provisions of paragraphs 2.1 through 2.7 and paragraph 2.11 of FAA Selection Order 1010.51A when replying to Mark X (and ATCRBS) ground stations, except that modified performance is required as follows:

(a) In paragraph 2.7.1.2 read "9 dB" as "6 dB".

(b) In paragraph 2.7.5.1.2 read "77 dB" as "75 dB".

(c) In paragraph 2.7.12.2 read "18.5 dB" as "21 dB".

2.3.2 *Reply Characteristics.*

2.3.2.1 *ATCRBS.* The transponder shall reply to standard ATCRBS Mode A and Mode C interrogations under the conditions prescribed in FAA Selection Order 1010.51A, paragraph 2.7.1, except when inhibited from replying by an ATCRBS lockout condition or during recovery following a DABS reply. The transponder shall not reply to ATCRBS interrogations when subject to the conditions prescribed in FAA Selection Order 1010.51A, paragraph 2.7.2 for no reply. The transponder shall not generate ATCRBS replies or suppressions in response to interrogations for which P_1 is received during an ATCRBS suppression interval.

2.3.2.2 *ATCRBS/DABS All-Call.* The transponder shall reply to an ATCRBS/DABS Mode A or Mode C All-Call interrogation, except when inhibited from replying by a lockout condition or during recovery following a DABS or ATCRBS reply. The transponder shall not reply with greater than 10% reply to interrogation ratio (with either an All-Call, an ATCRBS, or a DABS reply) in response to an ATCRBS/DABS All-Call interrogation when the interrogation contains a P_2 pulse which satisfies the requirements for ATCRBS suppression, or when inhibited by an ATCRBS/DABS All-Call lockout condition. The transponder shall not produce a DABS All-Call reply in response to a CW transmission or a single pulse of long duration whose received amplitude variations do not meet the specifications for an All-Call interrogation. There shall be an ATCRBS reply and no ATCRBS/DABS All-Call reply to a P_1-P_3-P_4 transmission in which either of the following conditions is satisfied:

(a) A leading edge for P_4 is not detected within the interval from 1.2 to 1.8 μsec following the leading edge of P_3,

(b) The amplitude of P_4 is more than 6 dB below the amplitude of P_3.

The reply to interrogation ratio shall not exceed 10% for replies of any type if the conditions for an ATCRBS/DABS All-Call reply are otherwise satisfied, but the duration of P_4 is greater than or equal to 1.2 μsec.

2.3.2.2.1 *Suppression.* Suppression as described in FAA Selection Order 1010.51A, paragraph 2.7.4 shall apply to the responses to ATCRBS/DABS All-Calls.

2.3.2.3. *DABS.* The transponder shall reply to valid DABS-Only All-Call, Surveillance, Comm-A, Comm-S or Comm-C interrogations, which are correctly addressed and within specified limits of received signal amplitude, except when the transponder is in a recovery state from a prior DABS or ATCRBS reply. The transponder shall not reply to a DABS interrogation whenever any one or combination of the following conditions occur:

a. The decoded data bits corresponding to the Address-Parity field contain other than the aircraft's unique discrete address, or—in the case of a DABS-Only All-Call—if the decorded parity field contains other than an acquisition address (2.2.3.2.1).

b. A lockout condition inhibits recognition of interrogations from auxiliary DABS sensors (2.2.3.4.3.1).

c. An all-zero address in a Surveillance or Comm-A interrogation indicates that the interrogation is a DABS Broadcast transmission (for which no reply is specified).

d. A DABS sidelobe-suppression (SLS) condition inhibits replies.

e. The interrogation requests a reply which the transponder is not equipped to transmit.

The transponder shall not produce a discrete DABS reply to a CW transmission or a single pulse of long duration.

2.3.2.4 *DABS Sensitivity and Dynamic Range.* For any given interrogation conditions, the minimum triggering level, or MTL, is defined as the minimum input power level for at least 90 percent reply to interrogation ratio. When referred to the transponder RF port(s), the nominal value of MTL shall be −77 dBm, with a tolerance range of ±3 dB for any combination of the following conditions:

Modes—DABS Surveillance, DABS-Only All-Call, DABS Comm-A, DABS Comm-S, the DABS Comm-C.

Interference—none.

SLS——P_2 pulse absent.

RF port—either (if diversity equipped).

Other—any interrogation condition satisfying these specifications.

Under these conditions, the reply to interrogation ratio shall be at least 90 percent for any input power level between MTL and −24 dBm, shall be at least 99 percent for any input power level between (MTL +3 dB) and −27 dBm, and shall not exceed 10 percent for any input power level less than −84 dBm, referred to the transponder RF port(s).

NOTE.—For this MTL requirement, a nominal 3 dB transmission line loss and an antenna performance equivalent to that of a simple quarter wave antenna are assumed. In the event these assumed conditions do not apply, the MTL of the installed transponder system must be the same as that of the assumed system.

2.3.2.5 *DABS SLS.* The transponder shall not reply to DABS uplink transmissions in

which a sync phase reversal is not detected in the assigned interval.

2.3.2.6 *Dead Time.* After replying to an ATCRBS or DABS interrogation, the transponder shall be capable of replying to a following ATCRBS or DABS interrogation whose P_1 pulse is received at least 125 μsec following the transmission of the last pulse of the reply, provided the transmitter duty cycle limits of 2.3.2.8.2 are not violated.

NOTE.—It is recommended that the dead time be as low as possible to maximize the transponder round reliability.

2.3.2.7 *Random Triggering Rate.*

2.3.2.7.1 *Unwanted DABS Replies.* The transponder random triggering rate of unwanted DABS replies which result in false data transfers over the digital data link interface (see 2.3.8) shall not exceed one per hour.

2.3.2.7.2. *Squitter Rate.* When Squitter transmissions are not locked out, the interval between successive Squitters shall be random with a nominal mean value of one second and a standard deviation of 0.1 to 0.2 second. Squitter transmissions shall be capable of being inhibited via the Squitter Inhibit interface (see 2.3.6.4). Squitters shall be delayed following the decoding of an ATCRBS, an All-Call, or a correctly-addressed DABS interrogation until the completion of the corresponding reply. Squitter transmissions shall be delayed during transponder suppression intervals controlled by other avionics equipment in the aircraft. Squitter transmissions shall not be suppressed during ATCRBS sidelobe suppression intervals.

2.3.2.8 *Reply Rate Limiting.*

2.3.2.8.1 *ATCRBS Replies.* ATCRBS reply rate limiting shall operate in accordance with the provision of paragraphs 2.7.10.1 and 2.7.10.3 of FAA Selection Order 1010.51A.

2.3.2.8.2 *DABS Replies.* DABS All-Call and discrete replies may be included along with ATCRBS replies as part of the total reply sound used to determine the receiver sensitivity for ATCRBS reply rate limiting specified in 2.3.2.8.1. It is permissible for the sensitivity to DABS All-Call and discrete address transmissions to be reduced when ATCRBS reply rate limiting is in effect. If the ATCRBS reply rate limit is not exceeded and the provision of 2.3.2.6 and 2.3.4.1 are not violated, the transponder shall be capable of replying to all combination of ATCRBS and DABS uplink transmissions for which the resulting transmitter duty cycle is no greater than 2 percent, averaged over a 100-ms period.

2.3.2.8.3 *Squitters.* Squitters may be included as part of the total reply count used for ATCRBS reply rate limiting. The Squitter rate shall not be affected by reply rate limiting.

2.3.2.9 *DABS Peak Reply Rate.* At least once every four seconds, the transponder shall be capable of transmitting six short (56-bit) or three long (112-bit) DABS replies in each of five consecutive 5-millisecond intervals.

2.3.2.10 *Reply Rate, Extended Length Message (ELM) Transmissions.* Within a single 25-msec period, a transponder with ELM capability shall be capable of transmitting a minimum of twenty-four Comm-D (112-bit) transmissions arbitrarily spaced in the 25-msec period.

NOTE.—The transponder must handle one 16-segment air-to-ground ELM in 4 seconds (see 2.3.6.2). Twenty-four Comm-D transmissions are specified to allow a margin for reinterrogation in case of link failure.

2.3.3 *Lockout Control.* Replies to ATCRBS interrogations, replies to ATCRBS/DABS All-Call interrogations, and Squitters and replies to auxiliary discrete-address interrogations shall be independently locked out (i.e., the transponder shall be insensitive to such interrogations) upon receipt of an interrogation with the appropriate code bits set, as described in 2.2.3.4.3. Each lockout shall be cleared or unlocked independently of the others.

2.3.3.1 *ATCRBS Lockout Time-out-Duration.* The duration T_{AL} of the ATCRBS lockout time-out shall be 16±2 seconds.

2.3.3.2 *Squitter Lockout Time-out Duration.* The duration T_{SL} of the Squitter lockout time-out shall be 16±2 seconds.

2.3.3.3 *DABS Lockout Time-out Duration.* The duration T_{DL} of the DABS lockout time-out shall be 16±2 seconds.

2.3.4 *Recovery Times.*

2.3.4.1 *ATCRBS.* All transponder recovery times related to ATCRBS interrogations and replies shall be as prescribed in FAA Selection Order 1010.51A paragraph 2.7.7.2.

2.3.4.2 *DABS.*

2.3.4.2.1 *Receiver Desensitization.* Upon receipt of any pulse of more than 0.7 μsec duration, the transponder receiver shall be desensitized in accordance with the provisions of FAA Selection Order 1010.51A paragraph 2.7.7.1.

2.3.4.2.2 *Recovery from a DABS Interrogation.* Following receipt of a DABS interrogation in which either the address is not correct, or the data block is decoded, but there is no reply for reasons a, b, d, e, specified in 2.3.2.3, the transponder shall recover sensitivity after the end of the DABS interrogation at the rate prescribed for recovery times in FAA Selection Order 1010.51A, paragraph 2.7.7.2.

2.3.4.2.3 *Recovery from a Single Pulse.* In the event that a P_2 pulse is not received following a single pulse meeting the specifications for a DABS P_1 pulse, the transponder shall recover sensitivity at the rate prescribed for recovery times in FAA Selection Order 1010.51A, paragraph 2.7.7.2.

2.3.4.2.4 *Recovery from an ATCRBS Suppression Pair.* When ATCRBS is not locked out, ARCRBS suppression shall be in effect following the receipt of a P_1-P_2 suppression pair. If a DABS data block is not detected following a P_1-P_2 pair, the transponder shall recover sensitivity to DABS interrogations at the rate prescribed for recovery times in FAA Selection Order 1010.51A, paragraph 2.7.7.2. ATCRBS suppression pairs shall not otherwise interfere with the reception of DABS interrogations regardless of the ATCRBS lockout state of the transponder.

2.3.4.2.5 *Recovery from a Broadcast Transmission.* After receipt of a broadcast transmission (2.2.3.2.7), the transponder shall recover sensitivity by 128 μsec after receipt of the sync phase reversal.

2.3.5 *Code Interfaces.*

2.3.5.1 *Address Code.* A means shall be provided for setting the address code.

2.3.5.1.1 *Specific Acquisition Address Code.* A means shall be provided for setting of the variable bits of the specific acquisition address code (2.2.3.2.1.2).

NOTE.—It is preferable that the means for setting the address codes be associated with the installation mounting configuration, so that a change of transponder will not require further action to reset the address codes.

2.3.5.2 *Pressure-Altitude Code.* A means shall be provided for automatically selecting the 12-bit pressure-altitude code (specified in FAA Selection Order 1010.51A paragraph 2.7.13.2.5) for inclusion in ATCRBS and DABS replies.

2.3.5.3 *Maximum Airspeed Code.* A means shall be provided for setting of the maximum airspeed (MX) code.

NOTE.—It is preferable that the means for setting the code be associated with the installation mounting configuration, so that a change of transponder will not require further action to reset the code.

2.3.5.4 *Squitter Inhibit.* A means shall be provided for accepting an external signal to inhibit Squitter transmissions.

2.3.6 *Data Handling.*

2.3.6.1 *Standard Transaction Rates.* The transponder shall be capable of handling at least 30 Surveillance or Comm-A interrogations and at least 15 Comm-B replies in a four-second period with all transactions arbitrarily spaced within a single 25-msec interval.

2.3.6.2 *ELM Transaction Rates.* The transponder shall be capable of handling at least four complete sixteen-segment ground-to-air ELM's and one complete sixteen-segment air-to-ground ELM in a four-second period with all transactions arbitrarily spaced within a single 25-msec interval.

2.3.6.3 *Data Interface.* The transponder shall be capable of:

(a) Presenting the content, with the possible exception of the address code, of all properly decoded uplink transmissions which have been received by the transponder. This content shall be available within 1 second after receipt of a normal transmission and within 4 seconds after receipt of an ELM transmission.

(b) Accepting every downlink field which is not generated internally by the transponder, i.e., any class X field, for transmission to the ground. Such acceptance shall begin on or before the start of the reply transmission.

NOTE.—This requirement applies in addition to data link functions which may be integrated into the transponder. The interface will, with appropriate external equipment, allow for transfer of data from one ground sensor to another through the transponder.

2.3.6.3.1 *Unavailable Data.* If a reply is transmitted containing one or more data fields for which there is no available data input device, or for which there is an input device with no data to transmit, the transmitted data field(s) shall consist of all zeros.

2.3.7 *Synchronizing Interface.* A signal shall be presented by the transponder from which the time of receipt of the sync phase reversal of a synchronized interrogation may be determined with an accuracy of ±50 nsec.

This notice is issued under sections 307(b) and 312 (a) and (c) of the Federal Aviation Act of 1958 (49 U.S.C. 1348(b) and 1353 (a) and (c)).

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